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Data Collection and Presentation Procedures for the U.S. Army's Chemical Hazard Assessment Warning System (CHAWS)

Michael H. Merry

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DATA COLLECTION AND PRESENTATION PROCEDURES
FOR THE U.S. ARMY'S
CHEMICAL HAZARD ASSESSMENT WARNING SYSTEM
(CHAWS)

Michael H. Herry
Merry Weather Services

June 1986

Lawrence
Livermore
National
Laboratory

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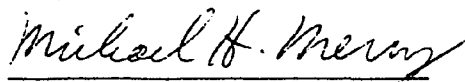
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DATA COLLECTION AND PRESENTATION PROCEDURES FOR THE U.S. ARMY'S
CHEMICAL HAZARD ASSESSMENT WARNING SYSTEM (CHAWS)

for Tooele Army Depot South, Utah

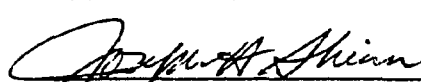
June, 1986

Prepared by:



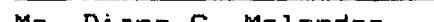
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PREFACE

This report has been prepared in response to the U. S. Army's request for an updated real-time air quality and meteorological monitoring, data processing, and data depiction system for stations situated on the periphery of a chemical munitions demilitarization incinerator pilot plant at the Tooele Army Depot South, located in central Utah about 40 miles (64km) southwest of Salt Lake City.

In connection with the establishment of this system, the author of this report, as sole proprietor of Merry Weather Services, has contracted the following scope of work with Lawrence Livermore Laboratory on a Personal Services Agreement (Contract No. 8607505):

- A. Provide design assistance with the air quality monitors to be located on the periphery of the plant.
- B. Assist in the design and analysis of data depiction systems to assure compliance with applicable Federal and State regulations.
- C. Provide proper quality assurance and calibration procedures to comply with guidelines.
- D. Prepare a report and operating procedures for a turn-key system for use by Army personnel.

It is in fulfillment of Part D of this scope of work that this report has been prepared.

It describes the site topography, station configuration, and sensor locations. It also gives operating procedures and methods of reporting air quality and meteorological data to comply with Federal and State regulations.

In addition, this report is being used as input to the Standard Operations Manual being prepared for the Army by the Ecosystem and Measurement Sciences Section, Environmental Sciences Division, Lawrence Livermore National Laboratory.

This report and the operating procedures have been written with the goal of compliance with the State of Utah Air Quality Approval orders, Utah State Department of Public Health, Bureau of Air Quality (1985) as well as the data needs of the U.S. Army's Chemical Research and Development Center and their Atmospheric Sciences Laboratory, Health and Safety Division, Environmental Health Department. Then, should the pilot plant be expanded or modified in such a way as to require the submission of a monitoring plan (see Section 1.2), portions of this report may be incorporated into the plan.

1.0 INTRODUCTION

This report describes the basic procedures and references more detailed documents for the operation of meteorological and air quality sensing instrumentation, data depiction and analysis systems for an incinerator pilot plant located at the Tooele Army Depot site near Salt Lake City, Utah. It discusses the site topography and climatology, sensor configuration, calibration, quality assurance and data reporting procedures for the monitoring system and demonstrates their compliance with applicable environmental regulations of United States Federal Government and the State of Utah.

1.1 Background

The United States Government has maintained a stockpile of highly toxic chemical agents and munitions for more than half a century. In order to develop adequate technology to safely dispose of these agents, it has been necessary to construct an incinerator pilot plant (IPP) at Tooele Army Depot about 40 miles (64km) southwest of Salt Lake City, Utah. Handling and transportation of these agents generates a small hazard due to the potential for accidental release of the agents into the atmosphere. While there have been no recent accidents and "...only three minor incidents in the last two years related to handling of chemical agents and munitions", and none of those cases released any toxic agent to the atmosphere (1), the possibility of such a release continues to exist and may increase slightly with the rate of handling for demilitarization purposes.

For this reason, the Army has realized the importance of updating their Chemical Hazard and Assessment Warning System (CHAWS) to include state-of-the-art technology. Such technology now includes the capability to model dispersion of atmospheric releases on a real-time basis using detailed onsite meteorological data.

The State of Utah has permit granting authority for new and modified sources under Federal Prevention of Significant Deterioration (PSD) Regulations and has ambient air quality quality monitoring guidelines similar to the Federal EPA Ambient Monitoring Guidelines for PSD. These regulations will apply to the criteria pollutants (those regulated under the Clean Air Act) being emitted by the demilitarization plant if certain conditions are met (see next section).

1. "Disposal of Chemical Munitions and Agents", Committee on Demilitarizing Chemical Munitions and Agents, Board on Army Science and Technology, National Research Council (1984)

1.2 Purpose

In order to model potential atmospheric releases of harmful material, it is necessary to obtain real-time meteorological data for immediate input to the U.S. Army's Chemical Hazard Warning System (which now uses the HAZARD.D2PC model to estimate downwind concentrations (2)). In case a minor release is discovered in arrears, such data will aid in depicting reconstruction of applicable meteorological scenarios.

The Utah Air Conservation Regulations (UACR, Section 3.6.5, b. (1) (a) (ii)), require that any major source modification be accompanied by a notice of intent along with "An analysis of ambient air quality in the affected area for each [criteria] pollutant that a new source would have the potential to emit in a significant amount... the analysis shall contain continuous air quality monitoring data gathered for the purposes of determining whether emissions of that pollutant would cause or contribute to a violation of the standard or any maximum allowable [i.e., PSD increment or other] increase in any [public access] area that the emissions of that pollutant would effect."

A major source modification for PSD purposes is defined as one resulting in a net increase of emissions of a criteria pollutant exceeding 250 tons per year, with more stringent requirements for 28 source categories spelled out in the Federal PSD Regulations and the UACR. While the incinerator pilot plant does not appear to fit into those 28 categories according to the law and to officials of the Utah Bureau of Air Quality, it is possible that a net increase in emissions of oxides of nitrogen or other pollutants exceeding the 250 ton per year limit could result if certain modifications are made. In this case, the source would be subject to PSD review under the UACR. A monitoring plan would then have to be submitted and approved by the State before the monitoring data could be accepted in fulfillment of PSD or UCAR.

Offsite impacts could be below the de minimus monitoring exemption levels, in which case ambient air quality monitoring would not be required by the State of Utah. However, monitoring has already been conducted using older equipment at the same stations discussed in this report to assure a long-term continuous data base and observe any increase that could be due to emissions from the existing pilot plant.

2. "Personal Computer Program for Chemical Hazard Prediction (D2.PC)", Whitacre, C.G., Griner, J.H. III, Myirski, M.M., and Sloop, D.W. , Studies and analysis office, U. S. Army Chemical Research and Development Center, January 1986.

It is in order to greatly enhance this data base with real-time data acquisition and processing and to improve data quality assurance that state-of-the-art meteorological and air quality monitoring stations have been installed at Tooele Army Depot South.

1.3 Scope of Report

This report has been prepared to describe the site and the configuration and operating procedures of the system. It also discusses the data quality assurance, reduction and presentation methods proposed to generate tables and graphs of air quality and meteorological values to fulfill the needs of U.S. Army personnel as well as Federal and State requirements. In addition to this, it describes the archiving process for both the meteorological and air quality data bases, which may later be used for ambient air quality analysis and climatological assessment.

2.0 TOPOGRAPHY AND CLIMATOLOGY

The Tooele Army Depot South site is located on sparsely vegetated range land with grass and very few trees some 40 miles (64km) southwest of Salt Lake City, Utah. It is about 23 miles (37km) south of the Great Salt Lake and 16 miles (26km) south of the town of Tooele, Utah.

2.1 Topographical Description

The Tooele Army Depot South site rests on the gently sloping northeast side of Rush Valley, at an average elevation of about 5150 feet (1570 meters) above mean sea level (MSL). As can be seen in Figure 2-1, the Oquirrh Mountains rise more than five thousand feet above the site (to 10,626 feet MSL) just to the northeast. Fivemile pass is located about ten miles to the southeast, with smaller mountains rising toward the larger mountains at the south of the pass.

The Wasatch Mountains rise slightly higher (to over 11,000 feet MSL) and form a continuous north-south line from Great Salt Lake to well south of the site, about 12 miles (19km) to the east. South Mountain, about 10 miles north, presents only a minor interruption to the gradually rising valley elevation toward the south, where the valley narrows.

Figure 2-2 shows a small cliff running at a northwest-southeast an angle along the northern Tooele Depot boundary.

2.2 Site Climatology

The climate of central Utah is classified as mid-latitude steppe (semi-arid) according to the Koppen method of climate classification. Much of the moisture of storms approaching from the Pacific is lost as rain or snowfall on the Sierra Nevada and other mountains to the west, resulting in relatively little rainfall most of the year.

While winter rain and snowfall is associated with mid-latitude cyclones, most summer precipitation falls in the form of light showers or thunderstorms associated with daytime heating and convection. A layer of dry air between cloud height and the surface often evaporates most or all mid-summer precipitation before it reaches the ground, but a large enough storm can penetrate this layer and even cause flash flooding. Summer thunderstorms are most common during the summer monsoon season (from about July 15 till September 15), when moisture is advected westward from the Gulf of Mexico. Cold fronts and other synoptic features generally have little influence during this period, and the Gulf moisture is advected in by the thermal low that persists over Arizona and interior California further to the southwest.

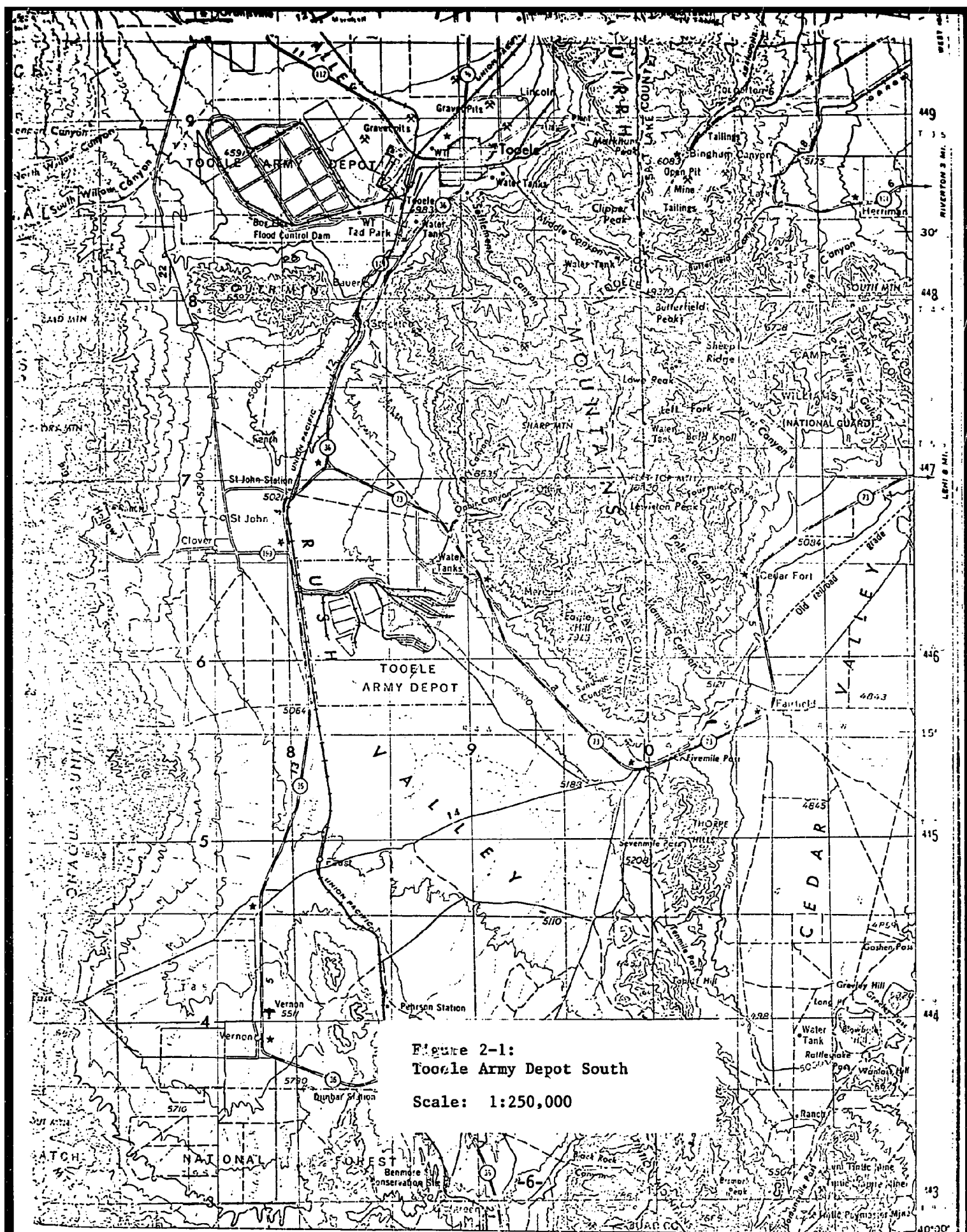
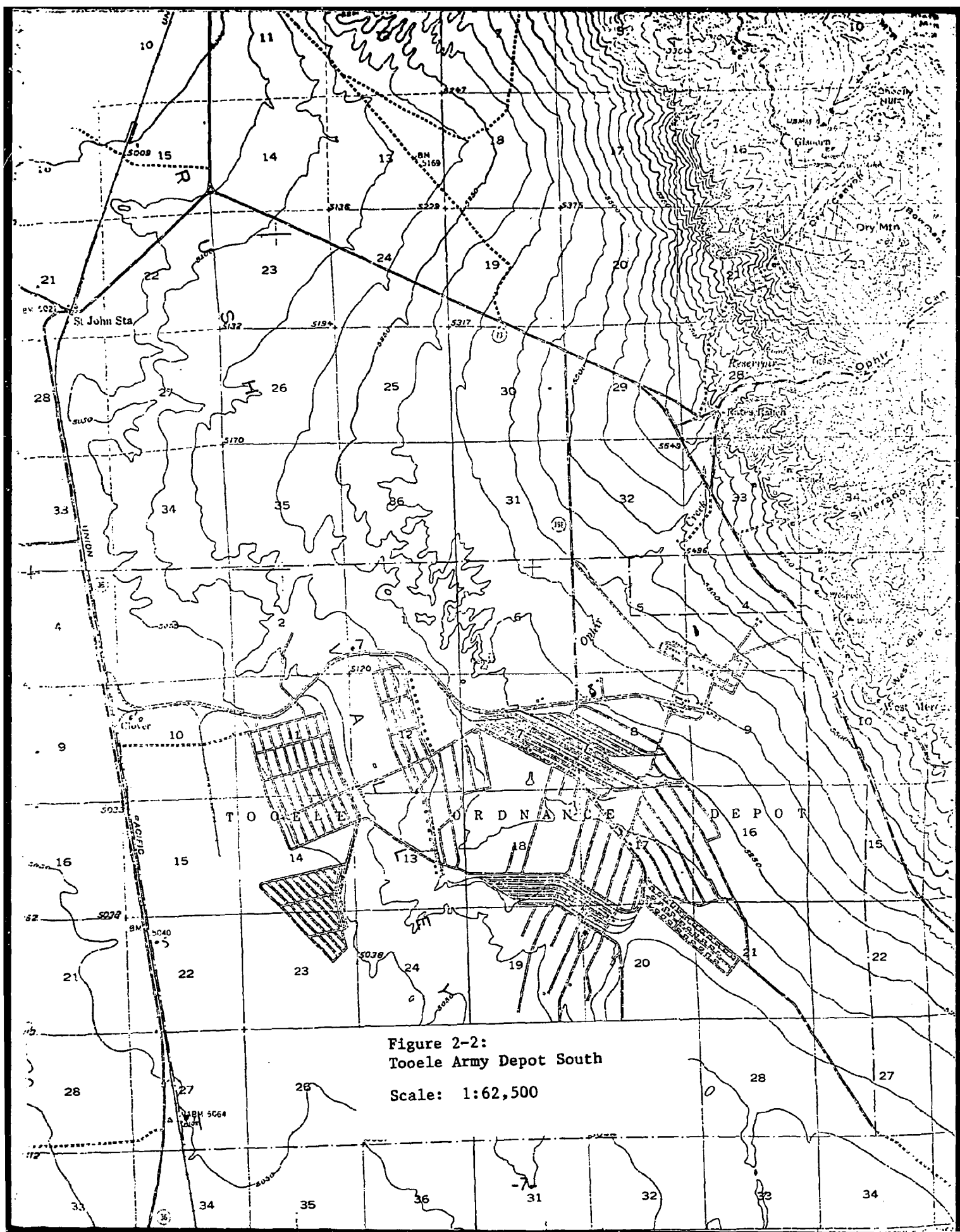


Figure 2-1:
Tooele Army Depot South

Scale: 1:250,000



Synoptic features are more noticeable during other parts of the year. Cold fronts passing from late September through mid April can bring sudden drops in temperature. These drops often reach 10C (18F) in only a few hours and can easily exceed 20C (36F) in a 24-hour period.

2.3 Local Climate Regimes

The average annual temperature at the Tooele site is near 10C (50F). The diurnal temperature range is large. Preliminary scans of onsite data from mid-April to mid-June (1986) show ranges of 20C to 30C (36F to 54F). Early morning lows were usually in the 0C-5C range (below 41F) for this period with afternoon highs in the range of 25-30C (77-86F).

The nocturnal drainage flow is usually observed to be from the northeast or southeast. Cold frontal passages have been observed to disrupt the pattern, creating a flow from the north or northwest. Local daytime lake breezes from Great Salt Lake do not often reach the site unless associated with a synoptic northerly flow, due to the intervening elevated terrain.

More information on the local climate will be available upon further analysis of the data.

3.0 AIR QUALITY AND METEOROLOGICAL SENSORS

In order to adequately characterize atmospheric dispersion throughout the Tooele Army Depot South site, it has been considered necessary to construct a number of meteorological towers near the site's outer perimeter as well as a tall one in the center. The purpose of this pattern is to depict local variations in wind and stability and to intercept a plume in several directions around the compass.

The air quality and meteorological sensors are briefly described below. More detailed information and calibration procedures are given in the manuals for the respective instruments.

3.1 Tower and Sensor Configuration

Towers have been placed in eight directions in an approximately square pattern surrounding the pilot plant. Each of these eight towers is 10 meters (33 feet) high, with sensors at the top for wind direction, wind direction standard deviation (σ_{θ}), wind speed, and temperature. They surround a square about 4 miles on a side (16 square miles). Each tower is about 2 miles from the next one around the square.

Of the 10-meter towers described above, the four not in the cardinal directions from the plant have no other sensors and are described below as "Type One". The stations in the cardinal directions (east, south, west, and north) are described below as "Type Two" because, in addition to the type one configuration, they also have air quality sensors in their instrument shelters at the base of the towers.

The stations are numbered sequentially around the site. They start with the east site and proceed around clockwise in the order of the directions given above. Those in the cardinal directions, then, are numbers 1, 3, 5, and 7. The central tower is number 9.

The central tower is referred to as "Type Three". It is 30 meters (98 feet) high and located near the pilot plant. It has only meteorological sensors. A configuration similar to that of the Type One stations exists at three levels on this tower--7.5, 15, and 30 meters. In addition, both temperature and relative humidity are sensed at 1.9 and 3.75 meters. The five temperature levels on this tower permit quite a reliable calculation of the temperature profile (T^* , temperature as a function of the log of the height above ground), as well as moisture flux. Both of these parameters are useful in determining air density for heat and moisture flux measurements.

3.2 Meteorological Sensor Description

Each Type One configuration consists of a 3-cup anemometer, a horizontal wind direction vane, and a thermister (Handar Models 430A, 431A, and 433A respectively). The temperature and relative humidity sensors are combined at the lower two levels of tower number 9 in a Handar Model 435A dual sensor.

All instrumentation sensor models have been approved by EPA and the U.S. NRC for PSD monitoring and other environmental liscensing purposes. Each temperature and humidity sensor is protected by an inverted triple conical naturally aspirated radiation shield. Sigma Theta is calculated from wind direction fluctuations in the Handar software.

3.3 Air Quality Monitoring Analyzer Description

Each of the Type Two stations is similar and has EPA-approved state-of-the-art air quality analyzers for sulfur dioxide, ozone, and oxides of nitrogen. The latter instrument analyzes the concentration of NO and NOx and uses the difference between these values to calculate NO2. The data processing system only monitors NO and NOx signals and, like the analyzer, subtracts to get the NO2 concentration.

Monitor Labs has provided their latest analyzer models 8810 for ozone, 8840 for oxides of nitrogen, and 8850 for sulfur dioxide. They have also provided their calibrator. Calibrations span checks are to be conducted automatically every 23 hours and last for about an hour.

4.0 DATA ACQUISITION SYSTEM

Each of the nine monitoring stations contains a Handar 540A data collection platform (DCP) which stores data collected from the towers. Summaries of these data are transmitted via radio to the base station at regular intervals.

Wind speed and direction data are polled every second, while temperature is polled every 10 seconds. Air quality values are polled every 10 seconds. Wind and air quality values are averaged every 5 minutes by the Handar software, while temperature values are averaged every 15 minutes.

The data channels, station types, and station configurations by channel are summarized in Tables 4-1 through 4-3 below.

Table 4-1: HANDAR 540A DCP CHANNEL CONFIGURATION LIST FOR TOOELE SITE

Chan. No.	Description
1	Battery Voltage
2	Air quality, calibration signal
3	Air quality, NO
7	Air quality, O3
8	Air quality, SO3
9	Air quality, NOx
16	Temp. level 1 (deg. C) (1.9m)
26	Temp. level 2 (deg. C) (3.75m)
36	Temp. level 3 (deg. C) (7.5m)
46	Temp. level 4 (deg. C) (15m)
56	Temp. level 5 (deg. C) (30m)
18	Humidity level 1 (in %)
28	Humidity level 2 (in %)
31	Wind speed level 3 (meters/sec)
41	Wind speed level 4 (meters/sec)
51	Wind speed level 5 (meters/sec)
33	Wind direction level 3 (in deg.)
43	Wind direction level 4 (in deg.)
53	Wind direction level 5 (in deg.)
34	Standard dev. of wind direction level 3
44	Standard dev. of wind direction level 4
54	Standard dev. of wind direction level 5

Table 4-2: PLACEMENT OF STATION TYPES

Type	Station numbers
1	2, 4, 6, 8
2	1, 3, 5, 7
3	9

Table 4-3: STATION TYPE CONFIGURATION OF CHANNELS

TYPE 1

1	Battery Voltage
31	Wind speed level 3 (meters/sec)
33	Wind direction level 3 (in deg.)
34	Standard dev. of wind direction level 3
36	Temp. level 3 (deg. C)

TYPE 2

1	Battery Voltage
2	Air quality, calibration signal
3	Air quality, NO
7	Air quality, O3
8	Air quality, SO3
9	Air quality, NOx
31	Wind speed level 3 (meters/sec)
33	Wind direction level 3 (in deg.)
34	Standard dev. of wind direction level 3
36	Temp. level 3 (deg. C)

TYPE 3

1	Battery Voltage
16	Temp. level 1 (deg. C)
18	Humidity level 1 (in %)
26	Temp. level 2 (deg. C)
28	Humidity level 2 (in %)
31	Wind speed level 3 (meters/sec)
33	Wind direction level 3 (in deg.)
34	Standard dev. of wind direction level 3
36	Temp. level 3 (deg. C)
41	Wind speed level 4 (meters/sec)
43	Wind direction level 4 (in deg.)
44	Standard dev. of wind direction level 4
46	Temp. level 4 (deg. C)
51	Wind speed level 5 (meters/sec)
53	Wind direction level 5 (in deg.)
54	Standard dev. of wind direction level 5
56	Temp. level 5 (deg. C)

5.0 DATA PROCESSING AND PRESENTATION METHODS

This section describes the data depiction and summarizing software. It reviews the State and Federal quality assurance and data presentation guidelines for ambient air quality monitoring and shows how these requirements will be met.

All software is IBM-PC compatible and most is written in Fortran-77. It is designed for operation on an IBM PC/XT and an IBM PC/AT.

5.1 Meteorological Software and Data Depiction Graphics

The meteorological software reads the wind parameters for each five-minute period and temperature and humidity values for each fifteen-minute period. Using these average values, a program called WXSUMM creates a table of hourly averaged meteorological parameters.

A graphics package called WXGRAPH generates puff trajectory plots for periods of 20, 40 and 60 minutes prior to the observed wind values. It also depicts wind vectors for the 10-meter level for all nine stations. WXGRAPH may be operated continuously, while both programs can be run for any existing period of onsite data.

Atmospheric stability is calculated using the modified sigma-theta (MST) method with the vertical temperature profile (T*) being used to determine nighttime conditions. Under stable nighttime (positive) temperature profiles, stability is adjusted according to the measured wind speed. This method is approved by the State of Utah as given in Appendix D (part D) of their Air Quality Approval Orders (1985).

Wind and atmospheric stability parameters are shown in one of the tables discussed in Section 5.2.3. These hourly values are to be obtained off the same hourly data being used for WXSUMM. Wind roses for monthly or multi-monthly periods may be generated from this data base using the ROSE routine. They can be printed on a laser jet printer.

Details of operation of these software packages are presented in the Standard Operations Manual.

5.2 Air Quality Data Reporting Methods

5.2.1 Reporting Guidelines

The State of Utah, in conformance with their air quality State Implementation Plan (SIP), has certain standards and procedures for reporting air quality data to the Utah Bureau of Air Quality. These procedures help the agency officials to compare local ambient air quality to State and National Ambient Air Quality Standards (NAAQS), legislated under the Clean Air Act, as part of the ambient air quality analysis they may require if under PSD (see Section 1.2).

If the demilitarization incinerator pilot plant is modified to the point where it becomes subject to PSD review (over 250 tons per year increase of any criteria pollutant under certain conditions), then the air quality monitoring and reporting become subject to the above mentioned procedures as well as to quality assurance guidelines.

In order to assure proper data acquisition to meet the guidelines should they be required, the system is being operated according to the Standard Operations Manual. This manual describes EPA-approved monitoring and analyzer calibration procedures, data checks, data acquisition hardware and software operation procedures in detail. These procedures meet PSD guidelines.

"Data Acceptance Limits for PSD Monitoring Data within the State of Utah" are provided below as Appendix A. They provide accuracy, precision, calibration span and drift specifications for the system. The Standard Operations Manual describes procedures for complying with these limits.

5.2.2 Methods of Keeping Monitoring in Compliance

Quarterly audits and multi-point calibrations will be performed on air quality analyzers according to the above guidelines. Multi-point calibrations will also be performed upon repair or replacement of major components and at other times deemed appropriate by the Utah Bureau of Air Quality. "As found" and "As left" conditions will be documented for reporting to the Bureau at the required times (within 90 days of calibrations).

The goal of the data recovery will be to obtain the highest possible percentage of valid data. The minimum requirement will be 50 percent for each month, 75 percent for each calendar quarter and 80 percent for each year, per requirements. All valid data will be reported.

5.2.3 Data Reporting and Compliance

Appendix B shows the data reporting requirements that must be followed. Data averaging for the periods shown will be done using custom software developed for easy comparison to air quality standards. Should a modification be made to the pilot plant subjecting it to PSD review, the required pre and post construction monitoring data will be compared.

The software to be used and sample tables and graphs so generated are shown in Appendix C. (The DATA shown are FALSE and are being used for purposes of illustration only.) AQSUM will create monthly arrays containing air quality monitoring data. These arrays will be used by AQTAB to generate the following tables:

- * Hourly and daily mean and extreme data for a given station, pollutant, and month or quarter,
- * Mean and extreme (maximum and second maximum) hourly values for all pollutants by station (plus 3-hour for SO₂), and
- * Maximum hourly average concentration for all stations by day with concurrent meteorological conditions for a given pollutant.

The operator will be able to specify the data periods and tables required and operate AQTAB interactively. In addition to monthly data, tables can also be generated for quarters and annual periods. Annual averages can be calculated for sulfur dioxides and oxides of nitrogen for comparison to annual standards. Percent data recovery will be displayed in the tables. Ambient air quality trends can be deduced by studying tables and graphs.

The system operator can also generate horizontal histograms showing the number and percent of exceedences of a given air quality standard or other "reference concentration" for a given month as shown in the back of Appendix C. Note that the heavy area is a frequency distribution while the lighter area represents a cumulative frequency distribution. (These DATA are also FALSE and used for illustration only.)

To generate the graphs, the operator simply inputs the pollutant and data period into a program called AQHIST. The standard is used as a reference concentration by default, or the operator may enter a different value if desired. The program AQHISTS will then generate graphs using the arrays generated in AQSUM.

The details of the software operation are presented in the Standard Operations Manual.

APPENDIX A

DATA ACCEPTANCE LIMITS FOR PSD MONITORING DATA WITHIN THE

STATE OF UTAH

A. Data Acceptance Limits Based on Audits and Precision for Automated Analyzers

Data will not be accepted:

1. If the accuracy of the reported data for the analyzer is $\pm 20\%$ from the true value as determined by a quarterly performance audit, or other performance audits required by the permit granting authority. All audits must be performed before a scheduled calibration.

(Note: Performance audits cannot be used for data adjustments).

2. For those periods of time where the precision point for a precision interval varies by more than $\pm 25\%$ from the reference precision point established at calibration.

B. Data Acceptance Limits Based on Span and Zero for Automated Analyzers

Data will not be accepted for those periods of time:

1. Where the analyzer span drift between a span interval is more than $\pm 10\%$

2. Where the analyzer zero drift for one zero check interval is more than $\pm .015$ ppm for O_3 , SO_2 , NO_2 , and 1.5 ppm for CO.

C. Corrective Measures Based on Calibration Factors for Automated Analyzers

Calibration factors that vary by more than $\pm 25\%$ from the ideal calibration curve cannot be used to correct data. The analyzer must be recalibrated and adjusted to the ideal calibration curve.

D. Data Acceptance Limits Based on Audits for TSP

Data will not be accepted if the accuracy of the reported data for a sampler is more than $\pm 15\%$ from the true value as determined by a quarterly performance audit or by other performance audits required by the permit granting authority. All audits must be performed before a scheduled calibration. (Note: Performance audits cannot be used for data adjustments).

E. Corrective Measures Based on Precision for TSP

A quarterly deviation of more than $\pm 7\%$ between the colocated and reporting sampler will necessitate a systems check and recalibration of the TSP network.

F. Data Acceptance Limits for Meteorological Data Based on Audits

Data will not be accepted if a semi-annual performance audit or other performance audits conducted by the permit granting authority or its designee show the following results for accuracy:

1. If the wind direction alignment varies by more than 5 degrees from the north and the distance constant for the wind vane is greater than 5 meters.
2. If the wind speed error is greater than ± 0.5 mph.
3. If the ambient temperature sensor error is greater than ± 0.5 degree C.
4. If the temperature difference between ambient temperature sensors used to measure delta T is greater than $\pm .1$ degree C.

Note: Sensor cannot be adjusted prior to the audit and audit results cannot be used to adjust data. Wind direction data may be adjusted with a correction factor by performing a pre-audit calibration check. All corrections must be documented and submitted with the audit results. The audit results will then be evaluated with respect to the corrected data.

G. Data Acceptance Limits for Meteorological Data Based on Sampling Frequency

Data will not be accepted if the sampling frequency is less than:

1. 10 seconds for wind direction
2. 10 seconds for wind speed.
3. 30 seconds for temperature.

APPENDIX B

PSD AMBIENT DATA AND QUALITY ASSURANCE REPORTING REQUIREMENTS

Quarterly ambient data and quality assurance reports must be submitted to the Utah Bureau of Air Quality no later than ninety (90) days after each calendar quarter. Should monitoring begin during a calendar quarter, the missing month or months can be combined with next year's monitoring to complete the calendar quarter.

An annual summary report of all data collected during the monitoring period must be submitted to the Bureau of Air Quality no later than ninety (90) days after monitoring has been terminated.

The following ambient data and quality assurance results must be contained in quarterly and annual reports for acceptance and analysis:

I. Quarterly Report

1. Monthly printout with valid hourly and daily averages.
2. Monthly and quarterly high and second high value.
3. Monthly and quarterly averages.
4. Monthly and quarterly highest average:
 - 24 hour NO₂, SO₂, TSP, PM₁₀, Pb
 - 8 hour CO
 - 3 hour SO₂.
5. Quarterly audit reports for each analyzer with the indicated audit values being reported as a full scale % deviation from the true audit values. Include the slope of the line and the correlation coefficient. Calculate these values by the linear regression method.

Report the percentage difference for each audit concentration for each analyzer and each TSP sampler audited during the quarter with the method specified by EPA.
6. Six month meteorological audit results included in the appropriate quarterly report with audit results being reported in:
 - a) Degrees for wind direction.
 - b) Miles per hour for wind speed (also calculate the absolute average error in mph if more than one audit speed is used).

c) Degrees Centigrade for temperature.

7. Reports on any other than quarterly scheduled independent audits. This would include results of systems audits, performance audits and interlaboratory audits using unknown samples.

8. Monthly and quarterly percent data recovery.

II. Annual Report

1. Magnetic tape in SAROAD or other acceptable format with valid hourly pollution concentrations and atmospheric stability data; wind speed and wind direction from different measurement levels.

2. Annual averages: SO₂, NO₂, TSP, PM₁₀, Pb.

3. Highest 24 hour average: SO₂, NO₂, TSP, PM₁₀.

4. Highest 8 hour average: CO.

5. Highest 3 hour average: SO₂.

6. Highest 1 hour average: CO, O₃, SO₂.

7. Annual percent data recovery.

8. Wind roses:

a) Winter [October through March].

b) Summer [March through October].

9. Air quality trends: quarterly and annually.

10. Pre and post construction monitoring data comparison of:

a) Annual averages: SO₂, NO₂, TSP, PM₁₀, Pb.

b) Quarterly averages: Pb.

c) Highest 24 hour averages: SO₂, NO₂, TSP, PM₁₀.

d) Highest 8 hour averages: CO.

e) Highest 3 hour averages: SO₂

f) Highest 1 hour averages: CO, O₃, SO₂.

APPENDIX C:

DATA DEPICTION SOFTWARE, TABLES AND GRAPHS



AQSUM - READS HOURLY AVERAGE AIR QUALITY DATA TO CREATE TABLES AND GRAPHS

AQTAB - TABULATES HOURLY AVERAGES BY HOUR OF DAY AND DAY OF MONTH; CREATES
TABLES OF DAILY, MONTHLY AND QUARTERLY HIGH, SECOND HIGH AND AVERAGE
VALUES PER FEDERAL PSD AND UTAH BUREAU OF AIR QUALITY MONITORING GUIDELINES.

AQHIST - CREATES HISTOGRAMS OF HOURLY AIR QUALITY CONCENTRATION OCCURRENCES
AS PERCENT OF NATIONAL AMBIENT AIR QUALITY STANDARD

HOURLY AIR QUALITY DATA FOR TOOELE ARMY DEPOT
Parts per billion of Ozone for Station #1 (East) for May, 1986

JR	Hour ending at:																								AVE.	MAX.	2ndMX	Day
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
1	120	110	100	100	90	80	70	50	70	80	110	120	200	40	50	80	130	110	130	210	180	190	170	140	110	210	200	1
2	120	110	100	100	90	80	70	50	70	80	110	120	200	40	50	80	130	110	130	210	180	190	170	140	110	210	200	2
D 3	120	110	100	100	90	80	70	50	70	80	110	120	200	40	50	80	130	110	130	210	180	190	170	140	110	210	200	3
4	120	110	100	100	90	80	70	50	70	80	110	120	200	40	50	80	130	110	130	210	180	190	170	140	110	210	200	4
A 5	120	110	100	100	90	80	70	50	70	80	110	120	200	40	50	80	130	110	130	210	180	190	170	140	110	210	200	5
6	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	6
Y 7	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	7
8	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	8
9	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	9
10	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	10
D 11	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	11
12	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	12
F 13	120	110	100	100	90	80	70	50	70	80	110	120	200	40	50	80	130	110	130	210	180	190	170	140	110	210	200	13
14	120	110	100	100	90	80	70	50	70	80	110	120	200	40	50	80	130	110	130	210	180	190	170	140	110	210	200	14
15	120	110	100	100	90	80	70	50	70	80	110	120	200	40	50	80	130	110	130	210	180	190	170	140	110	210	200	15
16	120	110	100	100	90	80	70	50	70	80	110	120	200	40	50	80	130	110	130	210	180	190	170	140	110	210	200	16
M 17	120	110	100	100	90	80	70	50	70	80	110	120	200	40	50	80	130	110	130	210	180	190	170	140	110	210	200	17
18	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	18
D 19	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	19
20	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	20
N 21	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	21
22	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	22
T 23	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	23
24	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	24
25	120	110	100	100	90	80	70	50	70	80	110	120	200	40	50	80	130	110	130	210	180	190	170	140	110	210	200	25
26	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	26
27	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	27
28	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	28
29	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	29
30	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	30
31	120	130	150	10	20	40	50	60	70	60	50	70	90	110	130	150	20	50	70	50	40	40	30	40	80	150	150	31
AVE.	120	120	130	40	40	50	60	60	70	70	80	90	140	70	100	120	60	80	90	130	100	110	90	80	90	210	200	AVE
MAX.	120	130	150	100	90	80	70	60	70	80	110	120	200	110	130	150	130	50	130	210	180	190	170	140	110	210	200	MAX
2ndMX.	120	130	150	100	90	80	70	60	70	80	110	120	200	110	130	150	130	50	130	210	180	190	170	140	110	210	200	2nd
Hour	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVE.	MAX.	2dMX	

MEAN AND EXTREME AIR QUALITY VALUES FOR TOOELE ARMY DEPOT
Hourly (with 3-Hour SO₂) Concentrations in Parts per Billion for June, 1986

Pol't	Loca. Value	Station #1 (E) MAX 2ndMAX AVE	Station #3 (S) MAX 2ndMAX AVE	Station #5 (W) MAX 2ndMAX AVE	Station #7 (N) MAX 2ndMAX AVE	ALL STATIONS MAX 2ndMAX AVE
O ₃ 1HR	Conc. Time*	210 210 90 0120 0220	210 190 80 0120 0113			
NO _X 1HR	Conc. Time*					
NO 1HR	Conc. Time*					
NO ₂ 1HR	Conc. Time*					
SO ₂ 1HR	Conc. Time*					
SO ₂ 3HR	Conc. Time*					

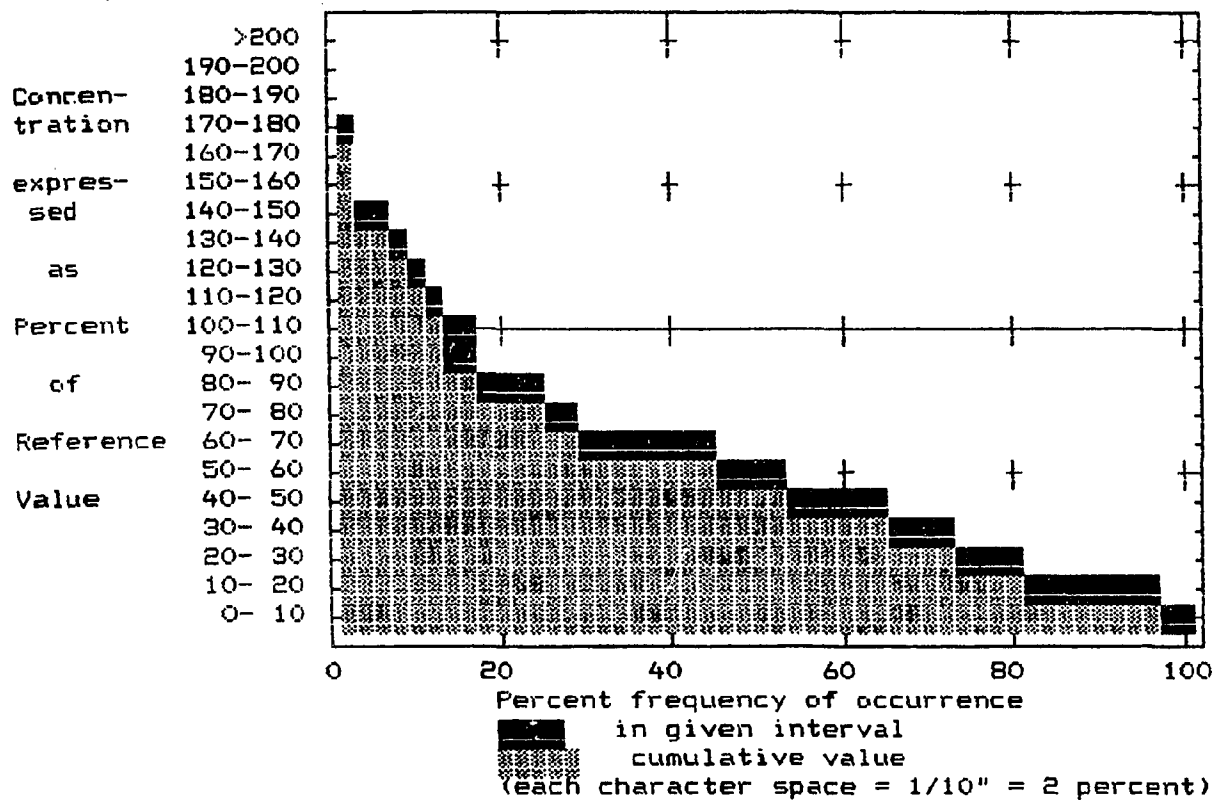
* Time (DAHR) of FIRST occurrence of maximum and secondary maximum (next lowest or same) concentrations

AIR QUALITY AND WIND PROFILE OF ALL STATIONS AT TOOELE, UTAH
Daily Maximum Ozone Concentration in Parts per Billion and coincident
Wind Direction (FROM, deg.), Wind Speed (m/s), and
Atmospheric Stability (by MST Method) for June, 1986

Day of mo	Station #1 (East)					Station #3 (South)					Station #5 (West)					Station #7 (North)					ALL STATIONS					Day
	Hr	WDir	Spd	Stb	Con	Hr	WDir	Spd	Stb	Con	Hr	WDir	Spd	Stb	Con	Hr	WDir	Spd	Stb	Con	Hr	WDir	Spd	Stb	Con	
D	1	9	280	9.0	C 65	9	270	8.0	C 60	9	260	9.1	C 55	9	290	10.8	C 63	9	275	9.2	C 61	9	275	9.2	C 61	1
	2	12	130	6.4	D 80	12	150	5.3	D 85	12	160	4.2	D 90	12	140	7.3	D 82	12	155	5.8	D 84	12	155	5.8	D 84	2
	3	18	320	12.0	B 40	18	350	12.7	B 35	18	020	9.4	B 34	18	310	7.8	B 41	18	340	10.5	B 37	18	340	10.5	B 37	3
A	4	9	280	9.0	C 65	9	270	8.0	C 60	9	260	9.1	C 55	9	290	10.8	C 63	9	275	9.2	C 61	9	275	9.2	C 61	4
	5	12	130	6.4	D 80	12	150	5.3	D 85	12	160	4.2	D 90	12	140	7.3	D 82	12	155	5.8	D 84	12	155	5.8	D 84	5
	6	18	320	12.0	B 40	18	350	12.7	B 35	18	020	9.4	B 34	18	310	7.8	B 41	18	340	10.5	B 37	18	340	10.5	B 37	6
Y	7	9	280	9.0	C 65	9	270	8.0	C 60	9	260	9.1	C 55	9	290	10.8	C 63	9	275	9.2	C 61	9	275	9.2	C 61	7
	8	12	130	6.4	D 80	12	150	5.3	D 85	12	160	4.2	D 90	12	140	7.3	D 82	12	155	5.8	D 84	12	155	5.8	D 84	8
	9	18	320	12.0	B 40	18	350	12.7	B 35	18	020	9.4	B 34	18	310	7.8	B 41	18	340	10.5	B 37	18	340	10.5	B 37	9
O	10	9	280	9.0	C 65	9	270	8.0	C 60	9	260	9.1	C 55	9	290	10.8	C 63	9	275	9.2	C 61	9	275	9.2	C 61	10
	11	12	130	6.4	D 80	12	150	5.3	D 85	12	160	4.2	D 90	12	140	7.3	D 82	12	155	5.8	D 84	12	155	5.8	D 84	11
	12	18	320	12.0	B 40	18	350	12.7	B 35	18	020	9.4	B 34	18	310	7.8	B 41	18	340	10.5	B 37	18	340	10.5	B 37	12
F	13	9	280	9.0	C 65	9	270	8.0	C 60	9	260	9.1	C 55	9	290	10.8	C 63	9	275	9.2	C 61	9	275	9.2	C 61	13
	14	12	130	6.4	D 80	12	150	5.3	D 85	12	160	4.2	D 90	12	140	7.3	D 82	12	155	5.8	D 84	12	155	5.8	D 84	14
	15	18	320	12.0	B 40	18	350	12.7	B 35	18	020	9.4	B 34	18	310	7.8	B 41	18	340	10.5	B 37	18	340	10.5	B 37	15
M	16	9	280	9.0	C 65	9	270	8.0	C 60	9	260	9.1	C 55	9	290	10.8	C 63	9	275	9.2	C 61	9	275	9.2	C 61	16
	17	12	130	6.4	D 80	12	150	5.3	D 85	12	160	4.2	D 90	12	140	7.3	D 82	12	155	5.8	D 84	12	155	5.8	D 84	17
	18	18	320	12.0	B 40	18	350	12.7	B 35	18	020	9.4	B 34	18	310	7.8	B 41	18	340	10.5	B 37	18	340	10.5	B 37	18
D	19	9	280	9.0	C 65	9	270	8.0	C 60	9	260	9.1	C 55	9	290	10.8	C 63	9	275	9.2	C 61	9	275	9.2	C 61	19
	20	12	130	6.4	D 80	12	150	5.3	D 85	12	160	4.2	D 90	12	140	7.3	D 82	12	155	5.8	D 84	12	155	5.8	D 84	20
	21	18	320	12.0	B 40	18	350	12.7	B 35	18	020	9.4	B 34	18	310	7.8	B 41	18	340	10.5	B 37	18	340	10.5	B 37	21
T	22	9	280	9.0	C 65	9	270	8.0	C 60	9	260	9.1	C 55	9	290	10.8	C 63	9	275	9.2	C 61	9	275	9.2	C 61	22
	23	12	130	6.4	D 80	12	150	5.3	D 85	12	160	4.2	D 90	12	140	7.3	D 82	12	155	5.8	D 84	12	155	5.8	D 84	23
	24	18	320	12.0	B 40	18	350	12.7	B 35	18	020	9.4	B 34	18	310	7.8	B 41	18	340	10.5	B 37	18	340	10.5	B 37	24
H	25	9	280	9.0	C 65	9	270	8.0	C 60	9	260	9.1	C 55	9	290	10.8	C 63	9	275	9.2	C 61	9	275	9.2	C 61	25
	26	12	130	6.4	D 80	12	150	5.3	D 85	12	160	4.2	D 90	12	140	7.3	D 82	12	155	5.8	D 84	12	155	5.8	D 84	26
	27	18	320	12.0	B 40	18	350	12.7	B 35	18	020	9.4	B 34	18	310	7.8	B 41	18	340	10.5	B 37	18	340	10.5	B 37	27
	28	9	280	9.0	C 65	9	270	8.0	C 60	9	260	9.1	C 55	9	290	10.8	C 63	9	275	9.2	C 61	9	275	9.2	C 61	28
	29	12	130	6.4	D 80	12	150	5.3	D 85	12	160	4.2	D 90	12	140	7.3	D 82	12	155	5.8	D 84	12	155	5.8	D 84	29
	30	18	320	12.0	B 40	18	350	12.7	B 35	18	020	9.4	B 34	18	310	7.8	B 41	18	340	10.5	B 37	18	340	10.5	B 37	30
	31	9	280	9.0	C 65	9	270	8.0	C 60	9	260	9.1	C 55	9	290	10.8	C 63	9	275	9.2	C 61	9	275	9.2	C 61	31

CUMULATIVE FREQUENCY DISTRIBUTION FOR OZONE
for Tooele Army Depot, Utah

Maximum Concentration =
Secondary Maximum Concentration =
Mean Concentration =
Reference Concentration =
Number above Ref. Conc. =



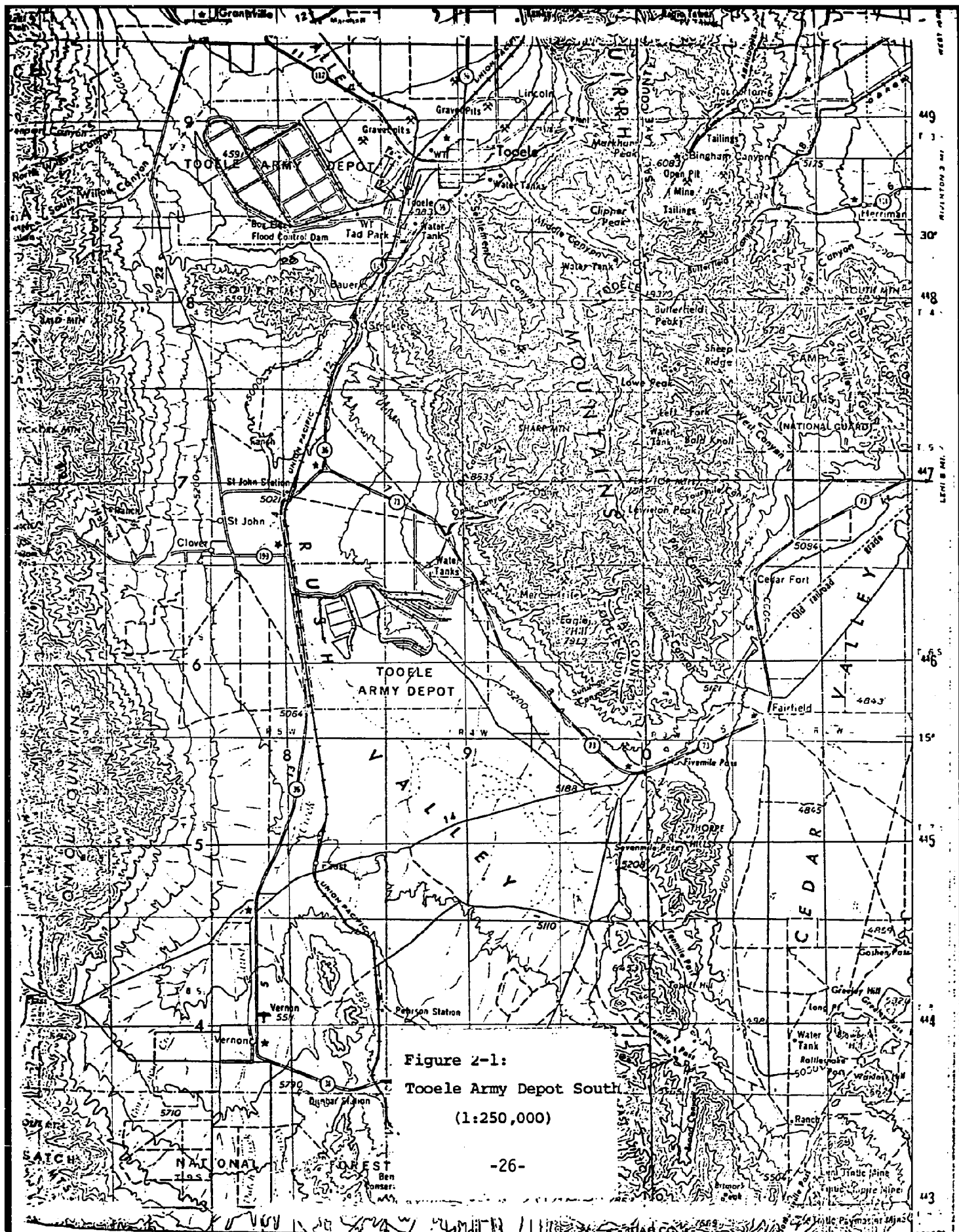


Figure 2-1:
Tooele Army Depot South
(1:250,000)

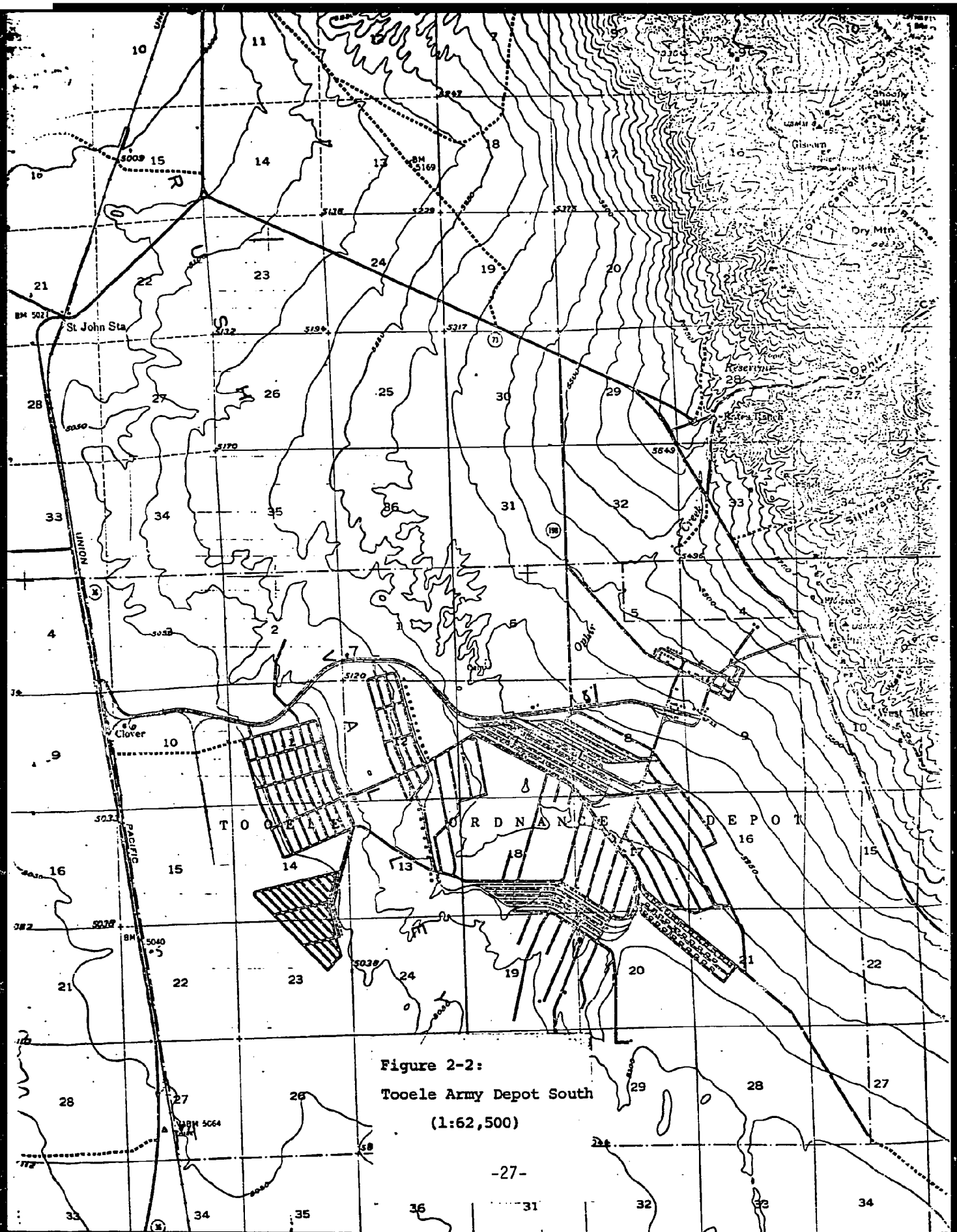


Figure 2-2:
Tooele Army Depot South
(1:62,500)